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DEMOGRAPHIC MONITORING OF PENSTEMON LEMHIENSIS

BEAVERHEAD NATIONAL FOREST

1992 PROGRESS REPORT

by

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I. INTRODUCTION

This report summarizes the results from four years of demographic monitoring studies in populations of Penstemon lemhiensis, a sensitive plant species that occurs on the Beaverhead and Bitterroot National Forests in Montana. Three permanent transects were established in 1989 on the Beaverhead National Forest. The monitoring results from 1989 through 1991 are discussed in earlier reports (Shelly 1990, Achuff and Shelly 1991, Shelly and Achuff 1992).

II. SPECIES INFORMATION

A. REVIEW OF PRESENT STATUS

1. **FEDERAL STATUS:** Penstemon lemhiensis is currently designated as a Category 2 candidate for federal listing by the U.S. Fish and Wildlife Service (U.S. Department of Interior 1993). Category 2 taxa are those "for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time."

Penstemon lemhiensis is also currently on the U.S. Forest Service Region 1 sensitive species list (U.S. Department of Agriculture 1991). Sensitive species are "plant and animal species identified by the Regional Forester for which population viability is a concern, as evidenced by: a.) significant current or predicted downward trends in population numbers or density, and/or b.) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (U.S. Forest Service Manual, Ch. 2670).

2. **STATE STATUS:** In Montana, Penstemon lemhiensis is currently ranked as S2 ("very rare and local throughout its range") by the Montana Natural Heritage Program (Heidel and Poole 1993). It is also currently categorized as "threatened" in a recent evaluation of rare plants in Montana (Lesica and Shelly 1991). A "threatened" species is one which is "likely to become endangered throughout all or a significant part of its range in Montana in the foreseeable future. Specific threats to known populations of these plants have been identified (Lesica and Shelly 1991). These state rankings do not currently provide any legal protection for P. lemhiensis.

B. UPDATE OF GEOGRAPHICAL DISTRIBUTION (MONTANA)

Four additional populations of Penstemon lemhiensis were newly discovered in Montana in 1992. Thus, the total number of known element occurrences in the state is now 48. Most represent recently discovered or relocated (1983-1992). One recent report (1987, Medicine Lodge Creek) has not been relocated, and one is an unverified historical record (1947) (Montana Natural Heritage Program database, Helena).

C. POPULATION DEMOGRAPHY

The three permanent monitoring transects established in 1989 were re-read on 3-4 August 1992, using the methods described in a previous report (Shelly 1990). The population and fecundity data are summarized in Table 1. The number of plants and the number of fruiting individuals for each transect over the four-year study period are displayed in Figures 1-3, pp. 4-6.

Decreases in the number of plants from the previous year occurred in two of the three study transects in 1992; the total number of plants in all three transects was 78. This total reflects a continuing severe decline, from 240 total plants in 1989, 215 in 1990, and 115 in 1991. The total decrease in the number of plants censused over the four-year study period has been -67.5%.

The total number of plants in the French Creek - Park Mine transect decreased by 12 from the 1991 total, resulting in a decline of 40%. Sixty-nine of the 84 established plants that were present when the transect was first read have died. The fecundity and vigor of the 15 established plants that have survived continued to be extremely low in 1992; none of them flowered or fruited.

The French Creek - Discovery Mine transect was the only one in which an increase in the number of plants occurred in 1992. The total number of plants increased by six from 1991, representing a gain of 17.1%. Twenty-eight of the 35 established plants that were present when the transect was first read have died. There were, however, 21 new plants present in the transect in 1992. Additionally, in contrast to the other two transects, there were three plants that flowered and fruited in this transect in 1992 (no plants flowered or fruited at the other two sites). The fecundity of these fruiting plants was very low, though; only 3.3 fruits per inflorescence were produced, and 69.7% of the total flowers produced did not yield fruits. Interestingly, all four seedlings that were found in this transect in 1991 survived to 1992. One possible reason for the survival of these seedlings, and the appearance of the 21 new plants, may be that the transect lies along a small draw, which probably provides for increased moisture and protection from drier summer conditions. This may also partially explain why the numbers of plants sampled in this transect have remained much more stable over the last four years than in either of the other transects. Reproductive output has drastically declined at this site, however, as in the other two transects.

The total number of plants sampled in 1992 in the Badger Pass North transect showed by far the greatest decline compared to 1991 levels. This decrease also represented the largest one-year decline in any transect since the study was begun. The total number of plants in this transect decreased by 31 from the 1991 total, resulting in a decline of 62%. One hundred-two of the 104 established plants that were present when the transect was first read have died, representing a near total loss of the original population sampled; 17 of the 19 plants now present have been newly established since 1989. As in the French Creek - Park Mine transect, none of the plants in the Badger Pass North transect flowered or fruited in 1992, compared to nine plants that flowered in the latter transect in 1991. No fruiting plants were found in the vicinity of this transect either, so no data on seed production are available for 1992.

In all three transects, the rosettes of the surviving plants were again much reduced in vigor in 1992. Unless conditions quickly and dramatically improve in future years, it is likely that continued loss of these individuals will continue.

As in the past, no evidence of severe surface or vegetation disturbance was noted at any study site in 1992, once again suggesting that the severe declines are due to climatic and/or other unknown environmental conditions. Although precipitation occurred in the spring and early summer over much of western Montana, the latter part of the summer was once again hot and dry.

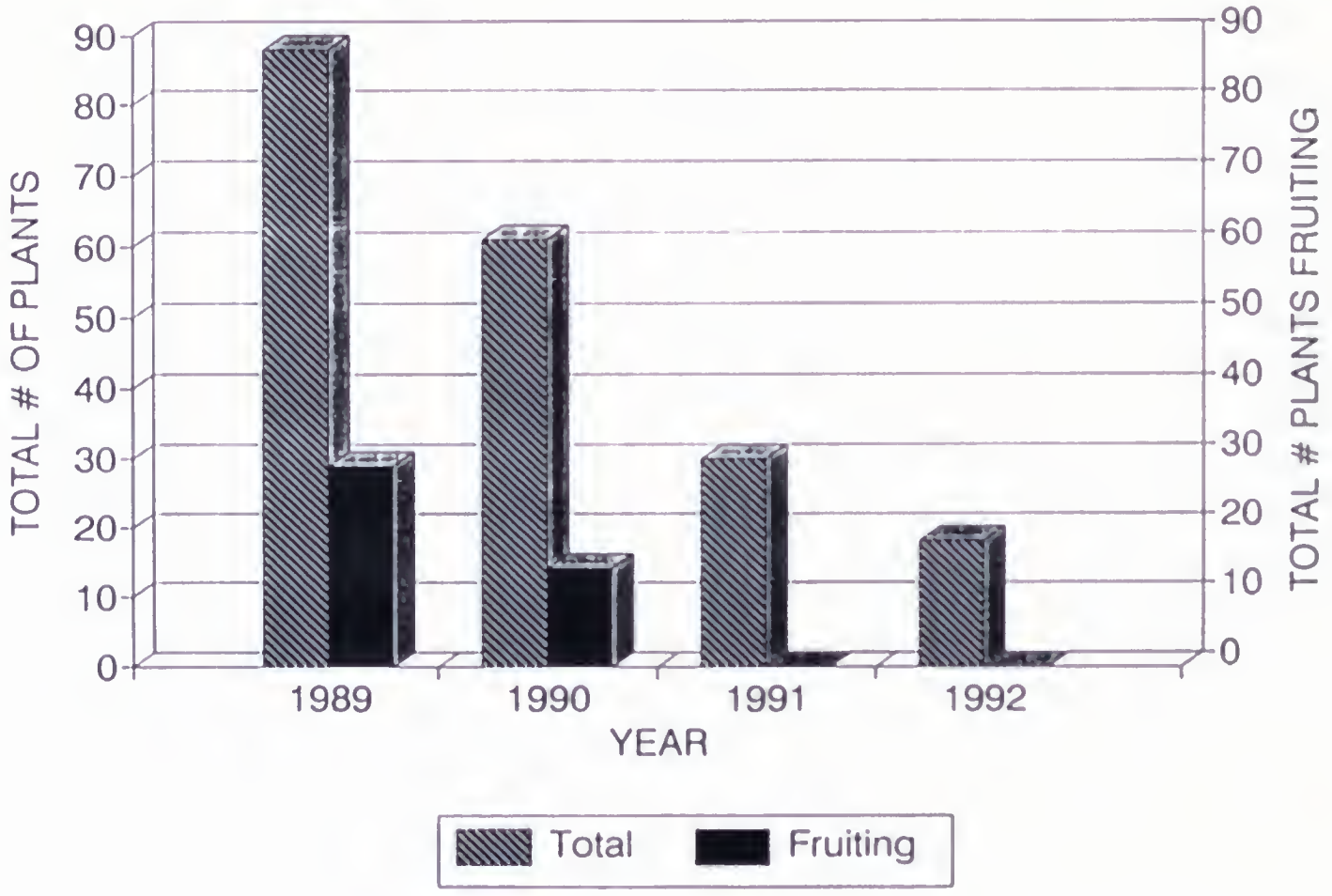
Table 1. Population density and fecundity data for *Penstemon lemhiensis* in long-term monitoring transects, Beaverhead National Forest, 1989-1992

TRANSECT	FRENCH CREEK - PARK MINE (25 plots)				FRENCH CREEK - DISCOVERY MINE (25 plots)				BADGER PASS NORTH (50 plots)			
	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
# plants/transect	88	61	30	18	35	47	35	41	117	107	50	19
density (plants/m^2)	3.5	2.4	1.2	0.72	1.4	1.9	1.4	1.64	2.3	2.1	1.0	0.38
# plants fruiting/transect	29	14	0	0	8	24	0	3	23	49	9	0
# fruits/transect	481	199	0	0	97	393	0	10	441	967	28	0
% plants fruiting	32.9	23.0	0	0	22.9	51.1	0	7.3	19.7	45.8	18	0
mean # fruits/fruiting plant	16.6	14.2	--	--	12.1	16.4	--	3.3	19.2	19.7	3.1	--
mean # fruits/inflorescence	11.2	8.0	--	--	8.1	9.1	--	3.3	13.8	9.3	1.9	--
% plants with 1 rosette	30.7	27.9	30.0	55.6	22.9	19.1	34.3	26.8	14.6	17.8	28.0	36.8
% plants with >1 rosette	64.8	67.2	66.7	33.3	77.1	59.6	54.3	22.0	74.4	76.6	68.0	42.1
% 1-rosette plants with fruit	11.1	5.9	0	0	0	33.3	0	9.1	11.8	15.8	0	0
% multi-rosette plants with fruit	45.6	31.7	0	0	29.6	75.0	0	22.2	24.1	56.1	26.5	0
% flowering stems browsed	23.2	4.0	--	--	47.8	23.3	--	0	3.0	2.9	20.0	--
% aborted flowers	N.R.	60.1	--	--	N.R.	70.0	--	69.7	52.4	67.4	82.5	--
mean # seeds/fruit (±s.d.)	32.7 ±11.2	33.8 ±8.9	N.R.	0	34.0 ±10.3	31.4 ±8.4	N.R.	N.R.	36.0 ±12.1	35.6 ±12.7	28.2 ±12.4	0
# seedlings/transect	4	3	1	2	0	10	4	21	13	6	2	4
# established plants not surviving to next year	--	33	32	14	--	2	11	15	--	12	55	34
# seedlings surviving to next yr	--	1 of 4	1 of 3	1 of 1	--	--	4 of 10	4 of 4	--	5 of 13	2 of 6	1 of 2
population growth rate	--	-31%	-52%	-40%	--	+34.3%	-25.5%	+17.1%	--	-8.5%	-53.3%	-62%

N.R. = not recorded.

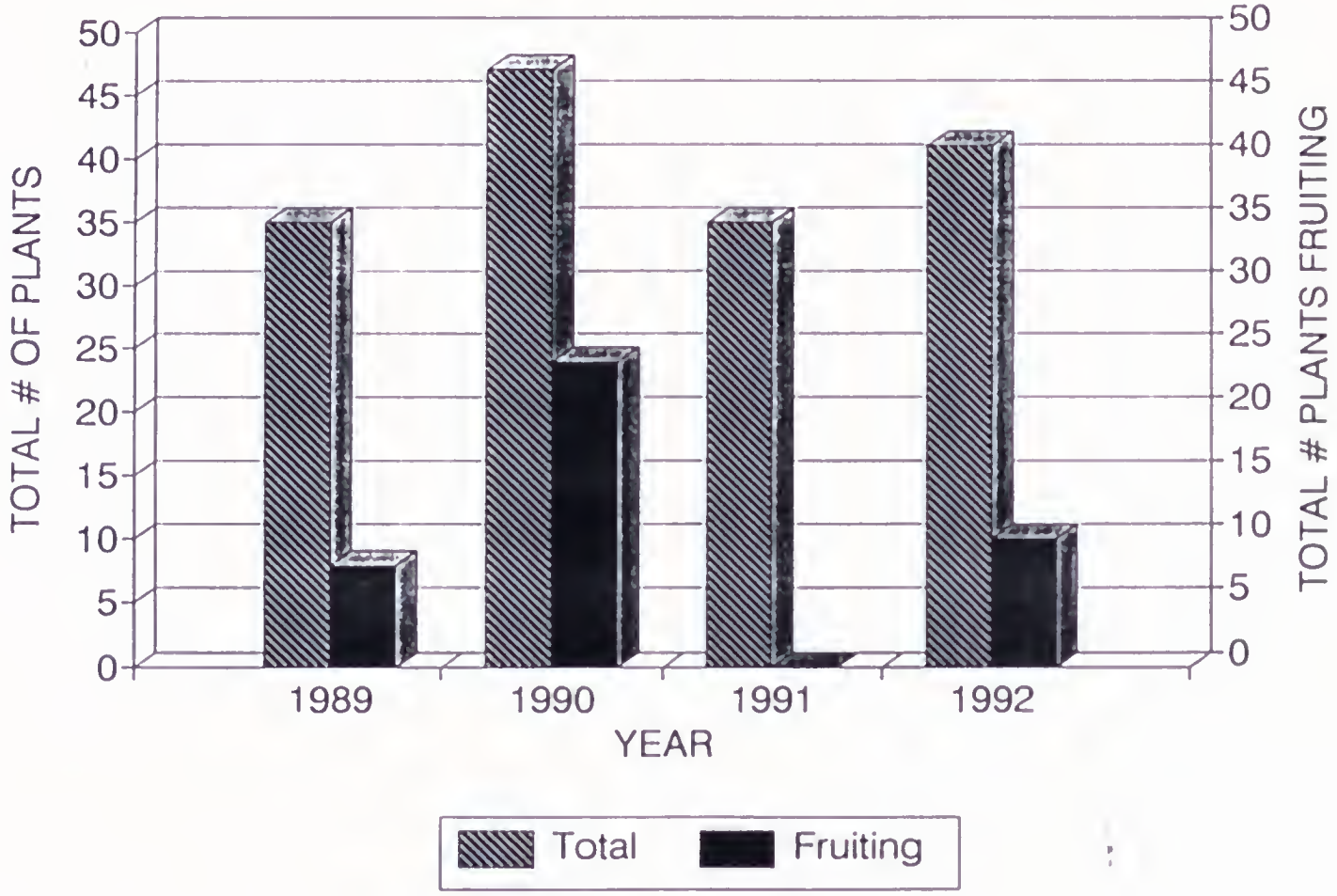
PENSTEMON LEMHIENSIS

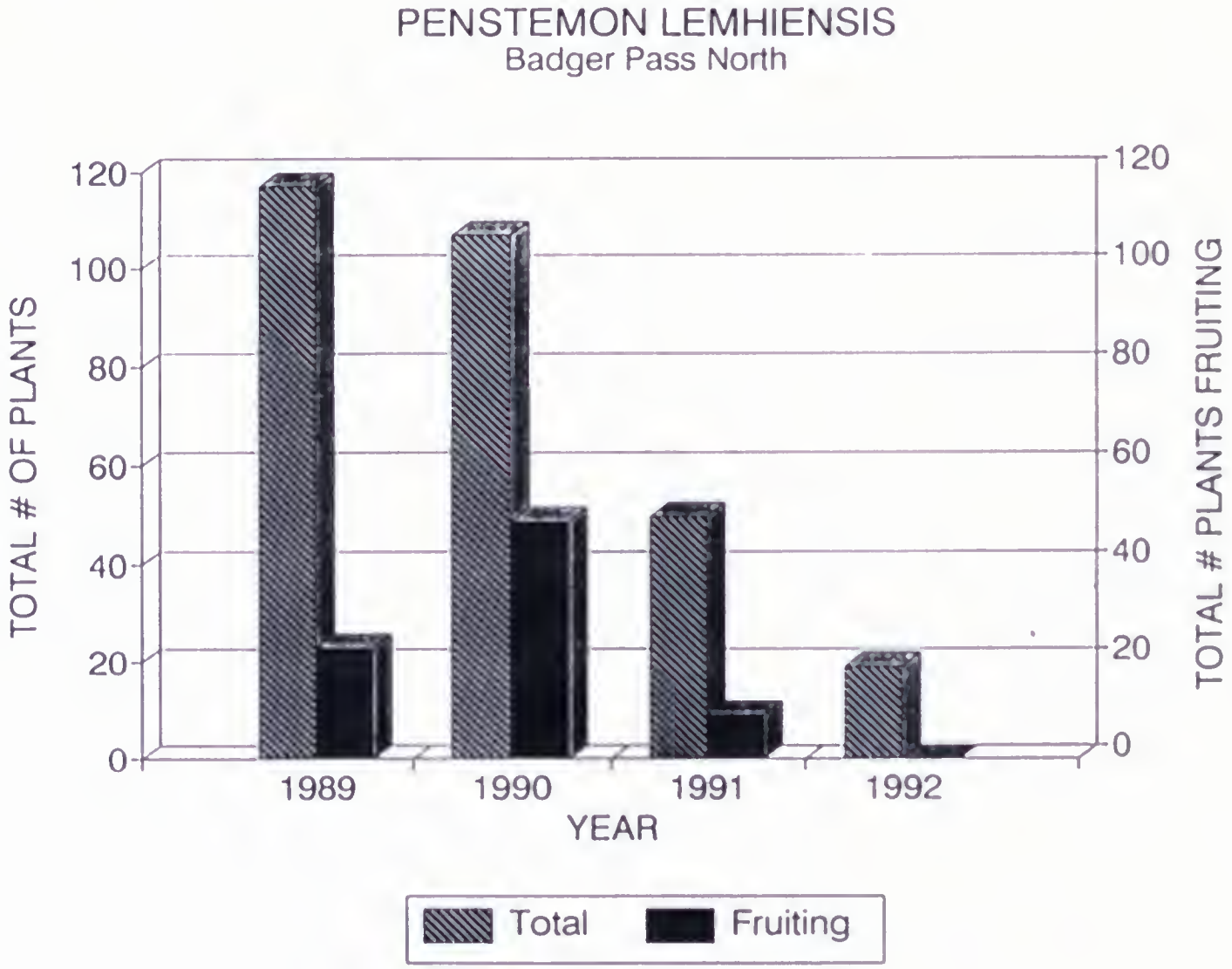
French Creek - Park Mine



PENSTEMON LEMHIENSIS

French Creek - Discovery Mine




PENSTEMON LEMHIENSIS
Badger Pass North
TOTAL # OF PLANTS
TOTAL # PLANTS FRUITING
120
100
80
60
40
20
0
1989
1990
1991
1992
YEAR
Total
Fruiting

III. ASSESSMENT AND RECOMMENDATIONS

The continuing declines in population numbers and/or fecundity, including the nearly complete loss of established plants in the Badger Pass North transect, indicate an ongoing demographic "bottleneck" in these, and probably many other, P. lemhiensis populations in southwestern Montana. As the declines have continued, the viability of these reduced populations, and that of the species' metapopulation as a whole, has undoubtedly been compromised. As noted earlier (Shelly and Achuff 1992), this raises the importance of conserving all populations that occur in native habitats, and especially the larger ones; the latter, "core" populations will be those that provide seed sources for establishment or reestablishment of populations in the future (= the "rescue effect" of the metapopulation as a whole). Similar monitoring studies simultaneously being conducted on BLM lands in southwestern Montana have shown much more stable population numbers at the two study sites involved (Heidel and Shelly 1993). This suggests that in other parts of the species' range populations will persist and hopefully provide such seed sources in the future.

The ongoing declines in the Forest Service transects indicate that Penstemon lemhiensis should remain on the sensitive species list for Region 1 of the U.S. Forest Service.

Preparation of a rangewide conservation strategy for this species is planned for federal fiscal year 1994. This strategy will include management and conservation guidelines for all extant populations of P. lemhiensis.

The three Forest Service transects should be read for at least one more year (1993). If population recovery begins, future readings at intervals to be determined should take place. If little or no recovery is noted in 1993, the transects could be read at longer intervals in the future (i.e., every 3-5 years), in order to periodically assess whether recovery ever begins. It would be appropriate to analyze data from the Forest Service transects and the Bureau of Land Management transects in a single document in the upcoming report to synthesize all Montana monitoring results for the P. lemhiensis.

IV. LITERATURE CITED

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V. APPENDIX - DEMOGRAPHIC MONITORING TRANSECT DATA

The performance of individual Penstemon lemhiensis plants in the permanent monitoring transects, from 1989 to 1991, is detailed below. The following codes are used:

- A - aborted flowers (no fruit development apparent)
- B - browsed flowering stem
- C - established immature plants (rosette with ≤4 leaves)
- D - dead
- F - fruit
- I - inflorescence (flowering stem)
- P - predated fruit
- R - rosette (basal tuft of leaves on mature plant)
- S - seedlings (cotyledons evident or rosette <15 mm in diameter).

The codes form a formula describing the state of each plant. For example, R5-I2-F17-A25 is a plant with 5 basal rosettes, 2 inflorescences, 17 fruits, and 25 aborted flowers.

FRENCH CREEK - PARK MINE

PLANT	1989	1990	1991	1992
1 a	R2	C2	D	-
b	R1	C2	D	-
c	R1	R4-B1	D	-
d	R3-I1-F7	R1	D	-
e	--	D	--	-
2	no plants	no plants	no plants	no plants
3 a	R1	R2	D	-
b	R1	R2	D	-
c	S	D	--	-
d	R1	R1	D	-
e	R1	D	--	-
f	R1-I1-F2	D	--	-
g	R1	R2	D	-
4 a	S	D	--	-
b	R1	R3	R2	D
c	R3	D	--	-
d	R1	D	--	-
e	R2	R1	D	-
f				R1 (new)
5 a	R2	D	--	-
b	R1	D	--	-
6 a	R4	R1	D	-
b	R1	D	--	-
c	S	D	--	-
d	R1-I1-F2	D	--	-
e	--	S	C1	R1
7 a	R1	D	--	-
b	R1	D	--	-
c	R1	D	--	-
d	R1	R2	R3	R1-C2
8 a	S	C	D	-
b	R2	D	--	-
c	R1	R1	D	-
9 a	R3-I2-F5	D	--	-
b	R6	R3	D	-
c	R10-I1-F11	D	--	-
10 a	R10-I4-F35-B1	D	--	-

	b	R3-11-F11	D	--	-
	c	R3-13-F13	D	--	-
	d	R3	D	--	-

FRENCH CREEK - PARK MINE (cont.)

	e	R2	R1	D	-
	f	R1	R1	R1	D
	g	R5-11-F6	D	--	-
	h	R1	R3	R2	R1
	i	R1	D	--	-
	j	R8-12-F31	R1	D	-
11	a	R6-11-F5	D	--	-
	b	R2	R2	R2	R1
	c	R6	D	--	-
	d	R3	D	--	-
	e	R8-11-F20-B1	D	--	-
	f	R1	R1	R1	D
	g	R12-11-F18	R6-13-F8-P4-A8	R3	R1
	h	R4-12-F19	D	--	-
	i				C1 (new)
12	a	R2-12-F35	D	--	-
	b	R4	R3-12-F4-P1-A24	D	-
	c	R4-12-F39	R1	C1	D
	d	R5-11-F13	R3	R4	R1
	e	R3-11-F7	D (buried)	--	-
13	a	R7-12-F17	D	--	-
14	a	R2	D	--	-
	b	R5-11-F12	D	--	-
15	a	R5	R4-12-F11-A28	D	-
	b	--	S	D	-
	c	--	--	C1	D
16	a	R7-12-F22	R3-12-F5-A11	C2	D
	b	--	--	S1	R1
17	a	R1 (dying)	R3	D	-
	b	R3	D	--	-
	c	R2-11-F7	D	--	-
	d	R5	R2-11-F2-A6	D	-
18	a	R5-11-F16	R3	D	-
	b	R7-13-F29	R3	R3	D
	c	R3	R3	R3	R1-C2
	d	--	S1	C1	D
19	a	R7	R5-11-F15-A12	R1	D
	b	R5	R5-12-F16-A16	R6	R4
	c	R4-11-F21	R1-11-F1-A8	D	-
	d	R4	R4-11-F7-A12	R2	R1
	e	R10-11-F13-B5	R13-14-F60-A108	R5	R1
	f	R8-14-F61	R6-12-F48-A29	D	-
	g	--	R1	D	-
20	a	R4-B1	R6	R4	D
21	a	--	R2	D	-
22	a	R2	R1	R1-C3	R1-C1
	b	R4	R3	R3	D
	c	--	R2	D	-
23	a	R1	D	--	-
	b	R6-B1-F1	R5	D	-
	c	R1-11-F3	C2	D	-

	d	R1	R2	C1	D
	e	R3	R1	D	-
	f	R4-B1	R4-I1-F3-P1-A12	R2	R1
	g	R3	R1	D	-
	h	--	C2	D	-
	i	--	R2	D	-

FRENCH CREEK - PARK MINE (cont.)

24		no plants	no plants	no plants	no plants
25	a	R1	R1	D	-
	b	R11	R7-I2-F13-A20	R6	R4
	c	R7-B1	R4-I1-F6-A6	R4	R3
	d	R9-B2	R7	R4-C2	C1
	e	R3	R1	R1	D
	f	--	R3	R1-C1	D

FRENCH CREEK - DISCOVERY MINE

PLANT		1989	1990	1991	1992
1	a	R4-B3	R5-I2-F24-A40	C1	D
	b	R3-B2	R1-I1-F7-A24	D	-
	c	R3	R3-I1-F3-A19	R3-C2	D
	d	R3	R4-I1-F9-A37	R4	D
	e	R2	R3-B1-A3	C1	R1-C1
	f	R4-B1	R4-I1-F9-A28	D	-
	g	R2	R2-I2-F13-A41	D	-
	h	R1	R2	C3	D
	i	R8-B2	R4-I1-F6-A9-B1-F3-A11	R6-C1	R2
	j	R1	R2-F2-A7-B1	R3	D
	k	R2	R3-I1-F5-A21	D	-
	l	R1	R1-I1-F10-A21	D	-
	m	R4-B2-F2	R6-I2-F21-A55-B3	D	-
	n	R1	R3-I2-F29-A54	R2	D
	o	R2	D	--	-
	p	R4-B1	R5-I3-F32-A72	R5	R5
	q	--	S1	C1	D
	r	--	R1	C1	C1
	s	--	S1	D	-
	t	--	--	S1	S1
2	a	R1	R3	R3	D
	b	R6-B4	R8-I1-F4-A14	R8	R4-C2-I1-F4-A10
	c	R6-I1-F1	R4-I3-F23-A51-B1	R2	D
	d	--	C1	R1	R1
	e	--	C1	C1	R1
	f	--	S1	D	R1
	g				S1 (new)
3-4		no plants	no plants	no plants	no plants
5		no plants	no plants	no plants	C1 (new)
6	a	R4-B1	R11-I1-F5-A37	R8	R2-I1-F1-A7
	b	R4-I1-F6	R6	R1	D
	c	--	S1	C1	D
	d	--	S3	C2	C2
	e	--	S2	D	-
	f	--	--	S1	S1
7	a	R1	R5	R5	R1
	b	R2-I1-F20	R1	R2	R2-C1
	c	R1	R1	R2	R1-I1-F5-A6
	d	R5-B1-F1	R4-I1-F5-A12	R4	0

e	--	R1	R1	R1
f	--	S1	D	-
g	--	S1	C1	D
h	--	S1	D	-
i	--	--	S1	S1
j	--	--	S1	S1
k				S1 (new)
l				S1 (new)

FRENCH CREEK - DISCOVERY MINE (cont.)

8	no plants	no plants	no plants	no plants
9 a	R6-I4-F7-B2	R1-I6-F75-A213-B1-F1-A16	D	-
b				S1 (new)
10 a				S1 (new)
b				S1 (new)
11-15	no plants	no plants	no plants	no plants
16 a	R4	R2-I1-F5-A12	R1	D
b	R8-I4-F29	D	--	-
17-22	no plants	no plants	no plants	no plants
23 a	R3-I1-F31	R2-I3-F18-A26-B1	D	-
24 a	R4	R4-I2-F24-A11	D	-
25 a	R2	R2 (low vigor)	D	-
b	R3	R3-I1-F10-A14	R7	R1-C4
c	R5	R3-I3-F29-A31	D	-
d	R1	R2	R2	C3
e	R5-B1	R6-I3-F21-A28-B1-A11	R5	D
f	--	S	C1	R1

BADGER PASS NORTH

PLANT		1989	1990	1991	1992
1	a	R3	R4-11-F15-A9	D	-
	b	R6-12-F17-A64 (unknown if the 64 fruits developed)	R1	D	-
	c	R1	D	--	-
	d	S9	C4, S5(D)	C1	S1
	e	R3-11-F11-A11	D	--	-
	f	R3	R1-11-F1-A15	D	-
	g	R3	R3-11-F11-A25	D	-
	h	S	D	--	-
	i	R5	R1-11-F16-A20	D	-
	j	R6	R8	R7-11-P1-A17	R1-C1
	k	--	S	R1	D
2	a	S	C	D	-
	b	S	S(D)	--	-
	c	S	S(D)	--	-
	d	R2	R1	R1	D
	e	R5	R1	D	-
	f	R2	D	--	-
	g	R2	R1-11-F0-A14	D	-
	h	R2	D	--	-
	i	R1	R3-11-F4-A20	R1	D
	j	R2	D	--	-
	k	C	R1	C1	D
	l	R2	R4	R4	D
	m	C	R3	R2	R1-C2
	n	R8	R4-13-F0-A78	R1	D
	o	--	S	S	D
	p	--	--	C1	D
3	a	R2	R3-11-F4-A19	R1	D
	b	R7	R5	D	-
	c	R1	R1	D	-
	d	R5-11-F8-A19	R5	R5	R2
	e	R5-12-F17-A25	R7-14-F17-A36	R2	D
	f	--	S	D	-
4-27		no plants	no plants	no plants	no plants
28	a	R7-13-F27-A15	R6-12-F29-A29	R1D	C1
	b	R3	R4	D	-
29	a	R2	R2-11-F14-A20	R2	D
30	a	R4-11-F3-A23	R4	R2	R2
	b	R2	R2	R4	R4
31	a	R3-11-F8-A16	R3	R6-11-A2	D
	b	R7-11-F23-A11	R11-13-F45-A46	R14	R8
	c	C	R1	R1	R1
	d	R5-11-F27-A10	D	--	-
32	a	no plants	no plants	no plants	R2-C1 (new)
33	a	R3-11-F9-A6-B1	R8-11-F27-A10	R2-11-F1-P4-A9	D
34		no plants	no plants	no plants	no plants
35	a	R1	R2	R4	R2
	b	R5	R11-12-F44-A13-B1	R8-11-F2-A5-B1	D
	c	--	--	R1	C1
36	a	R8	R14-11-F11-A8	R12-11-P5-A8	D

	b	R2	R2	R2-11-F1-P11-A18	D
	c	C	R2	R2	D
	d	R7	R10	D	-

BADGER PASS NORTH (cont.)

37	a	R3	R2	R5	R2
	b	R3	R4-12-F15-A25	D	-
	c	R6	R5-11-F32-A11	R4-11-F9-A10	D
	d	R3	R7-12-F25-A16	R9	C1
	e	R7	R7	R1	D
	f	R3	R5	R2-11-F1-P6-A16	D
	g	R6	R5	R2	D
	h	--	S	D	-
38	a	R1	R1	D	-
	b	R9	R5-12-F1-A90	D	-
	c	R1	R1	D	-
	d	R6	R5-12-F9-A51	D	-
	e	R4	R2	D	-
	f	R4	R4-14-F39-A35	D	-
	g	R11	R7	R1-C5	D
	h	R9-11-F12-A12	R9-14-F21-A88	D	-
	i	--	R2-12-F0-A41	D	-
39	a	R6	R3	D	-
	b	R2	D	--	-
	c	R1	R2	D	-
	d	R2	R4-B1	D	-
	e	R3	R3-11-F2-A5	D	-
	f	R3	R5-13-F20-A115	D	-
	g	R1-11-F14-A22	R3	R1	D
	h	R5+	R3-11	D	-
	i	R2	R4-13-F8-A40	D	-
	j	R5-12-F16-A64	D	--	-
	k	R1-11-F13-A17	R4-11-F16-A22	D	-
	l	R7-11-F29-A12	R7	R2	R1
	m	R6	R7-11-F33-A23	R4	D
	n	R6	R2-12-F20-A31	D	-
	o	--	R2-11-F9-A14	D	-
40	a	R1	R8-11-F7-A35	D	-
	b	R2-11-F0-A34	R3	D	-
	c	R5-11-F18-A15	R1	D	-
	d	R4	R3-13-F3-A90	D	-
	e	R5	D	--	-
	f	R3	R1-11-F0-A35	D	-
	g	R1	D	--	-
	h	R4-12-F11-A15	D	--	-
	i	R6-12-F31-A16	D	--	-
	j	R5	R1-11-F7-A22	D	-
	k	R13	R13-14-F16-A70	D	-
	l	R6	R9-14-F19-A127	D	-
	m	R2	R1	D	-
	n	R5	R7-13-F14-A72	D	-
	o	R5	R3-12-F5-A29-B1	D	-
	p	R3	R1-11-F0-A18	D	-
	q	R2	R2-11-F4-A15	D	-
	r	--	R2-11-F1-A40	D	-
	s	--	R1	D	-
	t				S1 (new)
	u				S1 (new)
41	a	R3	R6-11-F25-A8	R2-11-A8-B1	D
	b	R4-11-F25-A27	R12-12-F89-A22	R12-12-F1-A8-B2	R1
	c	R4	R6	R12	D
	d	R15±	R10-15-F11-A129	D	-
	e	R16	R23-13-F62-A33	R12-12-F8-P5-A13	D
	f	(part of d)	R5-11-F5-A34	C1	D
	g	--	S1	D	-

	h	--	S1	D	-
	i				C1 (new)
42	a	R4	R4-I2-F37-A49	D	-
	b	R5-I2-F41-A20	R11-I1-F23-A7	R5-I1-F1-P4-A7	D

BADGER PASS NORTH (cont.)

43	a	R8	R2	to F	D
	b	R1	R4	D	-
	c	R6-I1-F29-A3	R5-I2-F9-A55	D	-
	d	R9-I2-F30-A18	R3-I3-F47-A43	D	-
	e	R4	R5-I1-F15-A10	R3	D
	f	(part of a)	R4-I1-F13-A33	R6	D
44	a	R10	R11-I2-F19-A15	R4	D
	b	R8	R3	R3-I1-F4-A11	D
	c	--	--	S	D
45	a	--	R1	D	-
46-47		no plants	no plants	no plants	no plants
48	a	R1	R3	D	-
	b	R2	R3	R3	D
	c	R8-I1-F22-A10	R8-I3-F48-A36	D	-
49		no plants	no plants	no plants	no plants
50	a	R4	R3	D	-